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Body – Structure

Window Cutouts

When installing additional windows during the conversion process, it is important to implement practices that will not compromise the quality of the OEM vehicle. Additionally, standard procedures help to obtain consistent results. General Motors recommends the following:

! Use templates and fixtures when locating side windows. Use pre-existing features, such as the drip rail or body opening line, as reference points to locate templates and fixtures. (See Figures 1 and 2.)

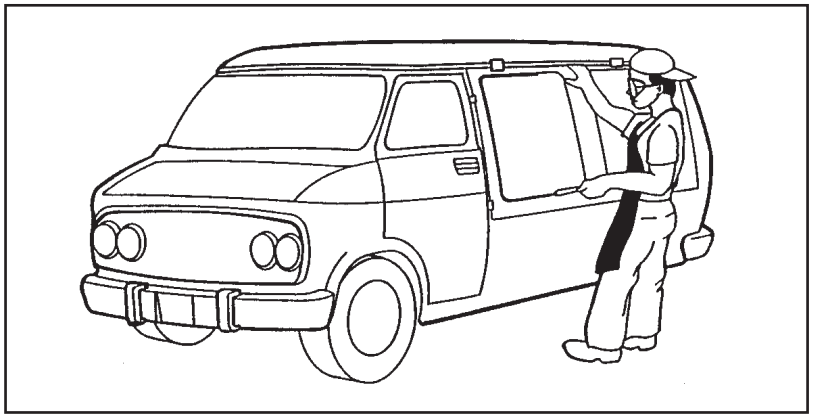


Figure 1

- When preparing raw metal edges, eliminate all sharp edges so metal preservative will adhere properly (Figure 3). Apply rust inhibitor around all body cutouts and holes drilled through exterior painted body panels. See the Upfitter Integration Paint and Sealing Guideline Manual.

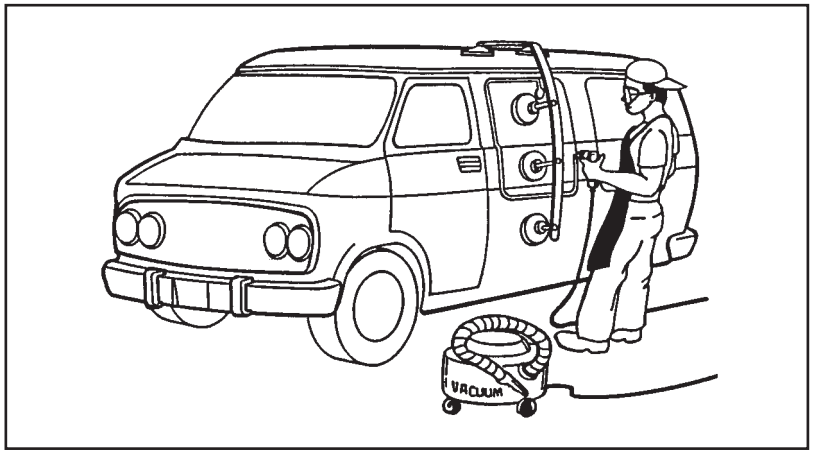


Figure 2

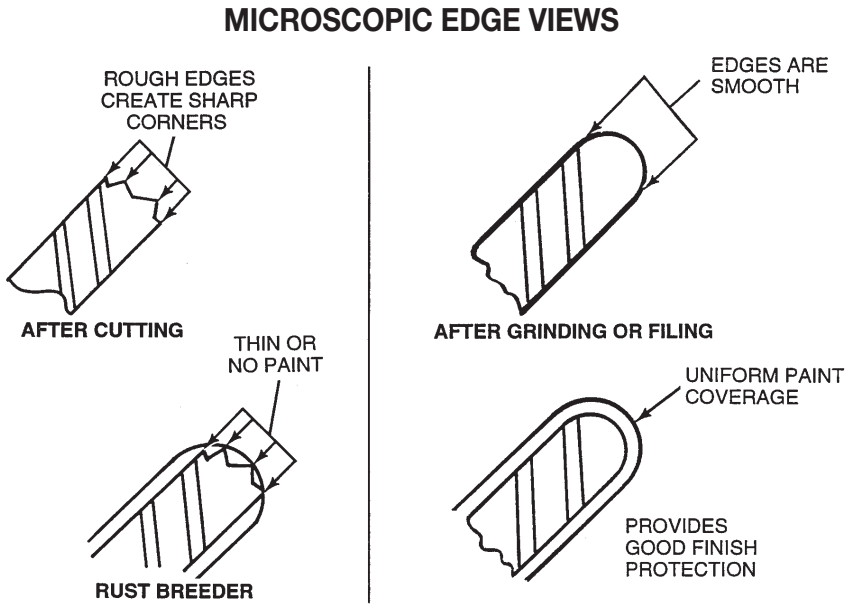


Figure 3

Body – Structure (cont'd)

- With a high-powered vacuum remove all metal debris (i.e., chips, ribbons, slivers, etc.) from the interior of the vehicle. This process eliminates potential damage to electrical wires and moving parts. It also helps to prevent premature rusting of the vehicle body.
- When adding exterior components, choose only those made of non-corrosive or properly plated materials.

Also, consider the corrosive effect of mating dissimilar metals when selecting materials. (See Paint manual for specific metal corrosion recommendations.)

CAUTION Conduct water testing to check for any leaks between the newly installed windows and the body, which may occur from the conversion process.

Consult the Incomplete Vehicle Document for recommended locations for installing side body windows.

All SVM-installed window and sunroof glass must meet FVMSS and appropriate state regulations, including those governing the use of shaded glass. Certification markings for any upfitter-installed glass must be visible on the vehicle. The SVM is responsible for recertifying the vehicle when installing non-OEM glass.

Side Wall Structure

It is necessary to assure that the strength of the modified sidewall structure is equal to or greater than that supplied with the OEM vehicle.

WARNING Install additional structures by bolting or welding them to the basic members of the body structure such as the roof rail, floor pan, wheel house, pillars or horizontal and vertical strainers.

CAUTION Refer to the Appendix I for general welding guidelines.

CAUTION For electrical system welding precautions, see the Upfitter Integration Electrical Guideline Manual — Electrical System Precautions section.

Roof Structure

CAUTION General Motors recommends the following guidelines for modifying G-Van and M/L Van roof structures (see the incomplete vehicle document):

- When adding a raised roof, do not remove the OEM roof structure forward of the B-pillar.
- To maintain cross-body stability, do not remove the last roof crossbow forward of the D-pillar.

WARNING Replace the original roof and roof bows only with structures of equal or greater strength.

- Before installing interior trim, conduct a water test to assure that there are no roof to body leaks.

Refer to the Incomplete Vehicle Document for guidelines on excessive roof console vertical heights which will obscure the vision through the rearview mirror.

Body – Structure (cont'd)

Floorpan

CAUTION Some conversion procedures require perforating or otherwise modifying the floorpan. Use extreme caution when working near fuel lines, fuel tank, exhaust system, heat shields and moving chassis parts.

! Use templates to accurately locate holes and drill stops to limit the drilling depth.

- Do not place floor covering, such as carpeting, so that it extends past the engine cover seal area or interferes with engine cover mounting clamps to eliminate CO intrusion, water leaks and noise intrusion. (Figure 4.)

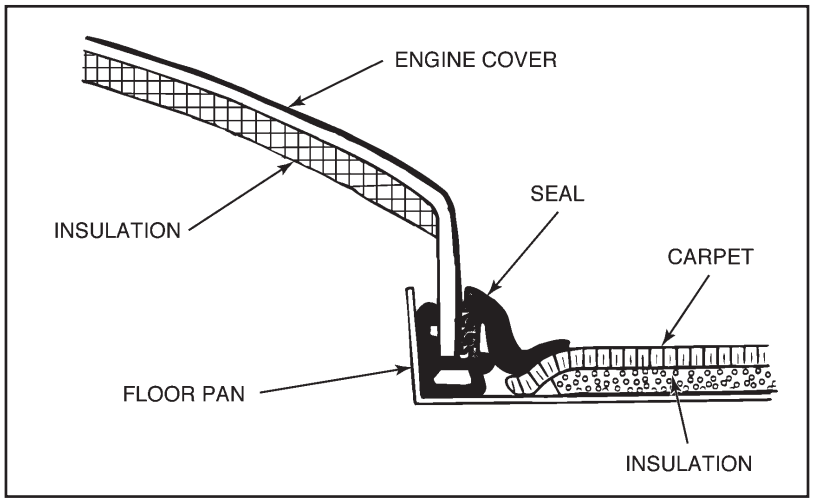


Figure 4

WARNING Use the proper reinforcements with rounded corners to anchor seat belts (Figure 5). This design helps to prevent “can-opening” of seat belt anchor plates and adjacent metal.

- Seal all holes in the floorpan to prevent carbon monoxide and water from entering the vehicle’s interior. Conduct appropriate occupant compartment pressure testing to assure the effectiveness of floorpan seals.

  See the Upfitter Integration Paint and Sealing Guideline Manual.

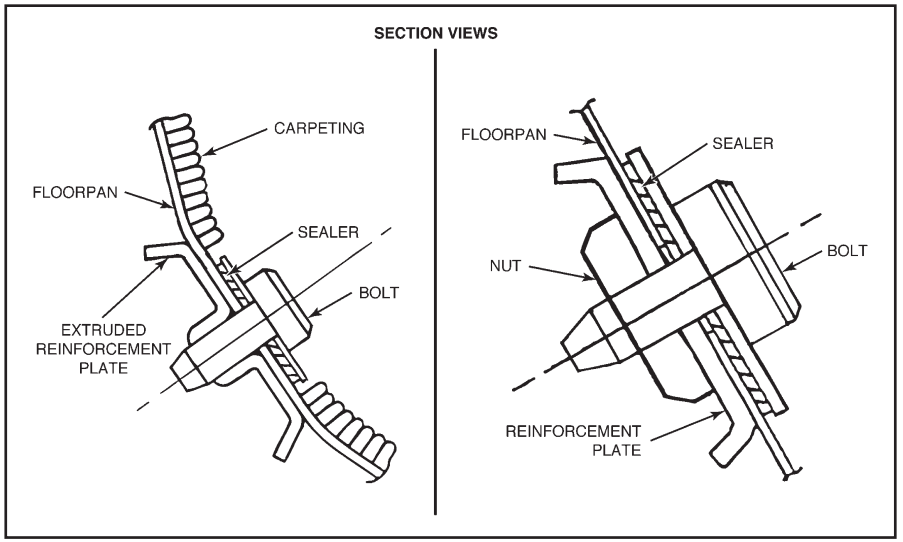


Figure 5

WARNING Take particular care in performing the above procedures to assure that vehicle occupants are not exposed to exhaust fumes and carbon monoxide.

Body – Weatherstripping

WARNING Do not remove any body insulation, including thermal or underbody heat shields, provided by General Motors. OEM insulation protects the vehicle body and passengers from excessive heat and reduces noise levels. The floorpan of the finished vehicle must be covered by the OEM thermal insulation mat or equivalent replacement. The SVM must certify that all materials installed inside the passenger compartment comply with all applicable FMVSS standards (including FMVSS302 - Flammability of Interior Materials.)

Weatherstrip Installation

To properly install weatherstrip (door opening seal), follow the procedure below:

1. Install weatherstrip at corner A (Figure 6). Seat weatherstrip onto body flange on each side of the corner.
2. Drape and install weatherstrip at dot areas B through F.

! Attach the weatherstrip to the body flange in six areas to equally distribute weatherstrip length around the door opening.

3. Seat remaining weatherstrip onto the flange by hand between the installation points.
4. Final installation may require using a rubber mallet in thick flange areas, and in corners to fully seat the weatherstripping.

CAUTION When using a rubber mallet, be sure to hit the weatherstrip squarely to the flange. Doing otherwise may cause undesirable spreading of the carrier, resulting in reduced retention.

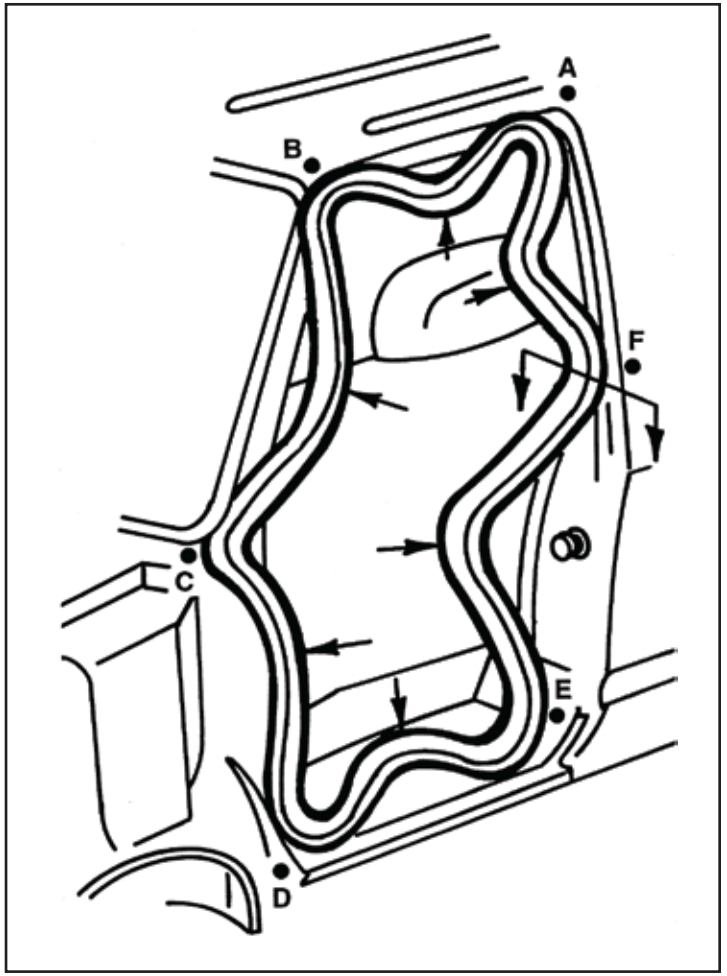


Figure 6

Body – Exterior Components

If using door seals to retain the trim material, make sure the trim adheres to the flange and is closely trimmed on the outer surface of the flange to eliminate wicking water into passenger compartment. See Figure 7.

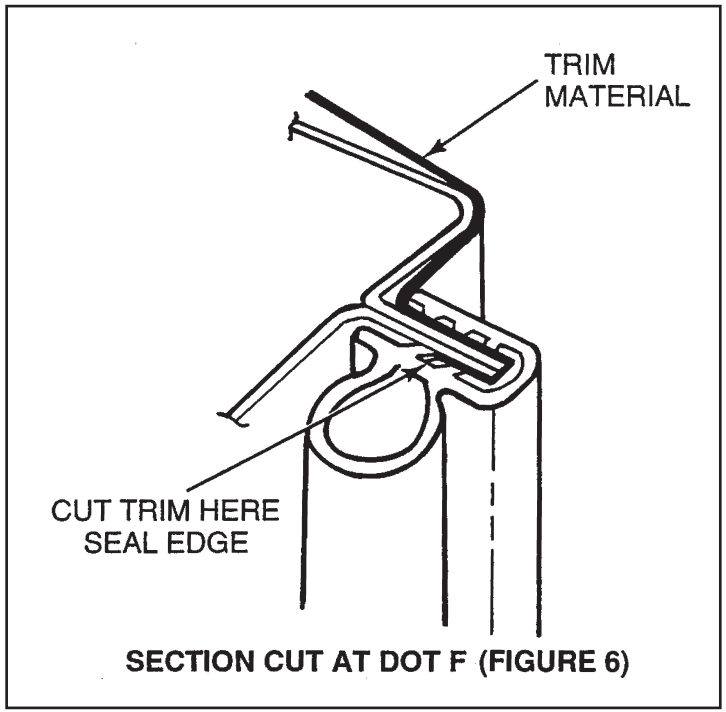


Figure 7

After installation is complete, inspect the weatherstrip for adherence to the following guidelines:

- **Corner fit** — The continuous corner should match the corner radius. Any rotation of the corner indicates that the fit is improper.
- **Proper seating** — The weatherstrip should be seated completely onto the flange in all areas, allowing the vinyl trim to lie smoothly around the entire door opening without waviness.
- **Carrier distortion** — Make sure that the carrier is free from distortion or spreading which may occur if it is hit improperly by a rubber mallet.
- **Secondary bulb** — The secondary sealing bulb should be continuously compressed on the body and door surfaces. Any areas of the weatherstrip with the bulb under the vinyl carrier should be removed and reinstalled.

Ladders, Spare Tire Carriers And Luggage Racks

When installing exterior components, it is important to align them properly. Include mounting pads to avoid damaging the paint or finish of the mounting surfaces. The following assembly procedures are recommended:

Mating dissimilar metals may have a corrosive effect on the assembly. Always consider this condition when selecting materials that will have direct contact with the vehicle body.

CAUTION

Do not attach spare tire carrier or ladders to vehicle's rear door. The door hinges are not designed to withstand this additional weight.

Include proper labeling and instructions for the use of SVM-installed accessories with the finished vehicle.

Body – Exterior Components (cont'd)

Lower Body Treatments

CAUTION To assure minimum OEM ventilation requirements were met for the exhaust and brake systems, conduct heat transfer testing and analyses to be certain that added air dams or running boards do not degrade the vehicle's airflow characteristics.

Do the same process to assure engine cooling and HVAC performance is within OEM minimum requirements.

Additional recommendations are:

- In order to provide sufficient clearance for steep driveway slopes, consider approach, departure and brakeover angles when designing lower body treatments.
- Do not remove or alter existing heat shields located on vehicle's underbody.

WARNING Do not place mounting attachments for lower body treatments in locations that would affect the integrity of the fuel or braking systems during normal use or a collision.

- Fasten added components or attachment brackets to structural members, not to sheet metal. This reduces squeaks and rattles, and the possibility of distorting class "A" exterior body panels.
- Be sure to allow adequate clearances for OEM moving parts and exhaust system when designing or installing lower body treatments.
- Mount road and fog lamps to the underbody structure, not to fascia material. Doing so increases mounting stability and reduces vibration, noise and glare.

Running Boards

Strength and corrosive properties are key considerations in the selection of materials for runningboards.

WARNING Running boards should be capable of supporting a minimum static load of 500 pounds with less than 5mm of deflection. Installing components of lesser strength could result in damage to the supporting structure and human injury.

- Apply a protective coating to the running board attachment points to prohibit the corrosion.

General Motors also recommends the following:

- Attach the running board to a structural member of the body only, not to the frame. A combined frame and body mounting system will cause frame noise, vibration, and harshness transfer into the body.
- Conduct the appropriate checks to assure sufficient clearance between the wheel and running board (i.e., on bumpy roads and sharp turns). This is especially important when running boards are integral with the wheel opening lip.
- When installing a running board to the body of a pickup truck, a two-piece construction should be used. Attach the front piece to the cab and the rear piece to the box.
- When installing a step bar to the frame of a pickup truck, a one-inch minimum clearance should be maintained to the body.

Body – Interior Components

The purpose of added interior components is twofold: to provide occupant convenience as well as a visually appealing environment.

WARNING It is the SVM's responsibility to assure that all added interior components comply with all applicable FMVSS standards (including FMVSS201 - Occupant Protection in Interior Impacts and FMVSS302 - Flammability of Interior Materials.)

Additional recommendations are:

- Attach all load-bearing interior hardware to the body structure to assure mounting strength.
- Do not install components with sharp edges or protrusions that may potentially harm vehicle occupants.

! The minimum radius for corners on interior components is 3.2mm (International Standard).

- Consider the range of hand and finger motion when designing and selecting locations for passenger convenience items.
- Aim added interior lighting for optimum passenger convenience, maximum lighting effectiveness and to avoid disturbing the driver's vision.
- Include maintenance and operating instructions for all added interior components with the finished vehicle.

! For information on practices recommended by the Society of Automotive Engineers, refer to SAE documents J1048 (Symbols for Motor Vehicle Controls, Indicators and Tell-Tales) and J1139 (Direction-of-Motion Stereotypes for Automotive Hand Controls).

Headliner System

The headliner system is a high visibility item and must meet or exceed all customer expectations for fit, finish, function and quality. As previously noted, headliner systems must conform to all applicable FMVSS standards (including FMVSS201 - Occupant Protection in Interior Impacts and FMVSS302 - Flammability of Interior Materials.) General Motors expects SVMs to implement processes that guarantee product consistency and those that drive continuous improvement.

- The design should avoid gaps between the headliner and B-pillar and C-pillar garnish moldings, and roof garnish moldings.
- To assure mounting integrity, attach all loadbearing interior hardware (e.g., overhead console) to sheet metal that is well supported.

WARNING Avoid placing hidden sharp edges between the headliner and the roof panel. Doing so may result in injury to passengers and damage to the headliner.

Headliner system components should be serviceable without damage to the headliner. **Refer to GM service manuals for recommended disassembly procedures.**

Sun Visors

General Motors recommends using the OEM visors in the upfitted vehicle. SVMs may, however, retrim the original visor to match the vehicle's interior. Sun visors must comply with all applicable FMVSS standards (including FMVSS101 - Controls and Displays, FMVSS201 - Occupant Protection in Interior Impact and FMVSS302 - Flammability of Interior Materials.)

Refer to GM Specification GMW14231 for materials suitable for retrimming the sun visor.

Body – Interior Components (cont'd)

Floor Covering

The floor covering system, which consists of carpeting, absorber and deadener material, must conform to all applicable FMVSS standards (including FMVSS302 - Flammability of Interior Materials.)

Carpeting

Install carpeting with a minimum weight of 18 oz. (i.e., 18 oz. Twilight). The minimum thickness for adequate carpet retention is 0.8" (20mm).

Choose carpeting that is free of loose threads, wrinkles, bubbles, frayed edges or attachment depressions. Also select materials that will lie flat against mating surfaces. Use only adhesives that are compatible with mating parts.

Sound Absorber and Deadener

Install sound-absorbing material wherever floor carpeting is added to a conversion vehicle.

- Use an insulator (deadener) with a sufficient thermal rating when it is exposed to higher exhaust system temperatures (see GM Specification GMW14231).
- Use a thermal cotton sound absorber to enhance interior acoustics (see GM Specification GMW14194).

Interior Trim Panels

Interior trim panels serve three important functions:

- Provides closeout for structural panels
- Secures other interior components
- Enhances the vehicle's interior styling

WARNING

Modifications should conform to the restrictions shown in "Incomplete Vehicle Document" in order to meet FMVSS occupant performance requirements. Like other interior components, trim panels must meet all applicable FMVSS standards (including FMVSS302 - Flammability of Interior Materials.)

Upfitters should also reference FMVSS 201, "Occupant Protection in Interior Impacts" for direction concerning interior fittings.

Plastic Trim Components

Select plastic trim that is free of burrs, flash, mold-parting lines and sink marks. If plastic trim is grained, match the grade and grain direction of the components that are related to it.

Wood Trim Components

WARNING

Round all wood-trim corners to eliminate sharp edges or protrusions that may result in passenger injury. The minimum radius for interior trim corners is 3.2mm.

Avoid installing wood trim in areas exposed to direct sunlight. Over time, the sun's ultraviolet rays will degrade the finish of the wood. All SVM-added decorative wood components should conform to GM Specification 2210M.

Body – Restraints and Seat Assemblies

Seating components and restraint systems must comply with all applicable FMVSS standards (including FMVSS201 - Occupant Protection in Interior Impact, FMVSS202 - Head Restraints, FMVSS207 - Seating Systems, FMVSS208 - Occupant Crash Protection, FMVSS209 - Seat Belt Assemblies, FMVSS210 - Seat Belt Assembly Anchorages and FMVSS302 - Flammability of Interior Materials.) Refer to the Incomplete Vehicle Document for additional information and requirements related to the systems and components discussed in this section.

The OEM restraint systems are designed to function properly with seating reference points and seat travel of the original equipment seats only. The non-OEM seats and belt systems that are installed by the SVM must be certified for compliance to FMVSS and CMVSS regulations.

Installation/Torque Specifications

To assure compliance to federal regulations, torque all added seat and seat belt fasteners to specification.

WARNING Avoid altering shoulder belt attachment zones (location and the surrounding structure). Such modifications require FMVSS recertification.

Additional precautions:

- **For driver and front passenger seats and belts**

Place seating reference points in locations identical to those specified in the “Incomplete Vehicle Document.”

— If, for any reason, it is necessary to remove OEM factory-installed front seat belts, reinstall them in their original positions using the proper tools. Torque all bolts to specification (see “Incomplete Vehicle Document”).

WARNING When drilling fastener holes through the floorpan, make sure that the fuel tank or fuel lines are not contacted. Use drill stops.

— Properly reinforce the floorpan at all fastener locations to avoid pull-through.

— Install backup washers under nuts at all locations.

WARNING Do not attach seat pedestals or seat belts through a layer of mat or carpeting. Doing so will cause compression of the material and result in a loss of torque.

WARNING All seat belt fasteners must be certified for compliance with FMVSS requirements.

Body – Fasteners

The term “fastener” refers to bolts, nuts, washers, screws, rivets, pins, staples and other commonly used attaching parts. Most fasteners are metric, but are very close in dimension to common Englishsystem fasteners. Consideration should be given to the full range of available fasteners to assure the appropriate selection. This will help to reduce problems with squeaks, rattles, corrosion, fit and cosmetic appearance.

Metal Fasteners

Always use fasteners that match the correct nominal diameter, thread pitch and strength of the mating part.

Original equipment metric fasteners, except “beauty” bolts (e.g., bumper bolts, cross-recess head screws), bear a marking on the head (Figure 8). This mark indicates the strength of the material making up the fastener.

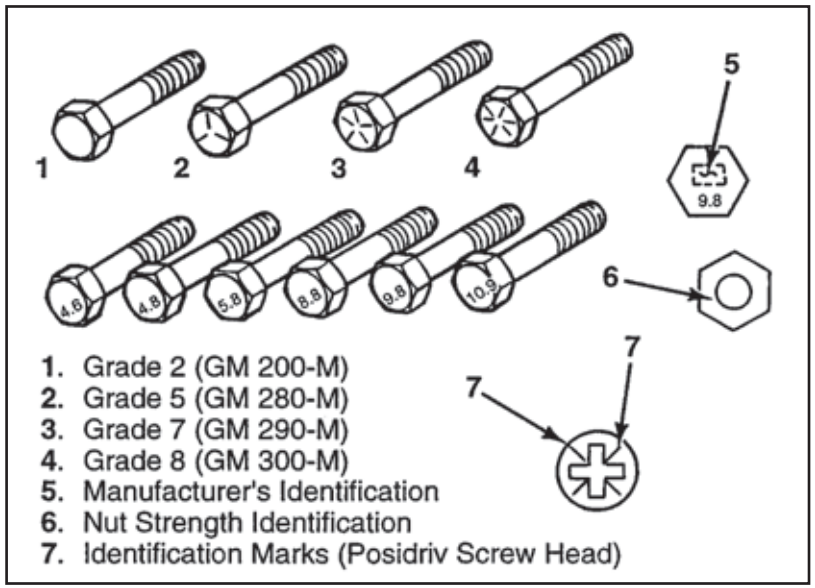


Figure 8

Metric cross-recess screws are identified as “Posidriv” or “Type 1A.” Either a Phillips or Type 1A cross-recess screwdriver can be used in Posidriv recess screw heads, but Type 1A crossrecess screwdrivers perform better.

General Motors recommends the following fastener process guidelines:

Purchase fasteners by part number rather than description to assure meeting the desired specifications.

- Use metric tapping screws incorporating Posidriv features on cross-recess heads.
- Use Posidriv nuts and bolts. They are designed to promote higher torquing ability and prevent slippage.
- Use metric, rather than English, fasteners. Never intermix metric and English fasteners (i.e., do not use English bolts with metric nuts, or vice versa). Also, use either all metric or all English fasteners within a vehicle system.
- Use self-drillers with milled (rather than forged) tips.
- Use hardened washers to assure consistent bearing surfaces. This allows positive sealing and is especially important in areas where gas and water may otherwise enter the vehicle.

WARNING: Use a torque-control gun to install seat and seat belt bolts. Doing so will provide optimum control and proper torque.

For specific information on fasteners, refer to
Industrial Fastener Institute – www.indfast.org
American Society of Mechanical Engineers – www.ASME.org
International Association for Testing Materials – www.ASTM.org
Society of Automotive Engineers – www.SAE.org
See Appendix II for “General Fastener.

Body – Fasteners (cont'd)

Plastic Fasteners

Although there are many types, only three make up about 80 percent of all commonly used plastic fasteners. They are:

- Trees — Not recommended because of service issues that occur after reinstallation. They have a tendency to come loose and cause squeaks and rattles after service. This type of fastener is made up of “branches” (or arms), a “trunk” (stem) and a base (head). Trees can vary greatly from one another with different stems, different kinds of points and especially, different types of heads.
- Grommets — Sometimes called a nut or screw grommet, the grommet is installed in a hole or slot in one panel. The second component is then fastened by a screw through the second component into the grommet hole. Grommets are labeled according to the type of hole they fit (i.e., square, oval or round). They can be two- or four-legged. Always consider hole size and grip range when selecting grommets.
- Pushpins — Recommended fastener. Pushpins are basically grommets with a wedge attached to them and come in three types: basic pushpins, screw rivets and Rivet-RLoks. They are used by inserting the pushpin through the hole and then pushing the pin through to expand the legs and wedge it into place.

  Pushpins may be either crossed or noncrossed, depending on whether the legs are attached to each other at the tip. Screw rivets are similar to pushpins except they can be removed by unscrewing. Hole size and grip range are also important criteria when selecting this type of fastener.

Squeaks and Rattles

Because squeaks and rattles contribute greatly to customer dissatisfaction, it is important to recognize their possible causes and identify ways of eliminating them. The guidelines below can assist the SVM to develop designs that minimize or eliminate squeaks and rattles.

- Ideally, the part should not rattle when shaken. However, if the component’s function makes this impossible, hide or relocate the part and use sound-deadening material to isolate it.
- Design attachment brackets and adjacent parts with the following considerations:
  - rigidity
  - ability to self align during assembly
  - clearance or interference fit
  - temperature and environmental conditions
  - surface and surrounding materials

! As much as possible, avoid cantilevered designs and components that cannot be positively attached.

- Preload moveable parts to restrict their movement.
- Secure components tightly in static state.

See APPENDIX III for related design and assembly principles that eliminate unwanted noise.

For specific information on fasteners, refer to
Industrial Fastener Institute – www.indfast.org
American Society of Mechanical Engineers – www.ASME.org
International Association for Testing Materials – www.ASTM.org
Society of Automotive Engineers – www.SAE.org
See Appendix II for “General Fastener.

Body – Appendix I

Welding Guidelines and Precautions

When welding anywhere on the vehicle, it is important to take precautionary measures to assure the safety of the technician and prevent damage to the vehicle or its systems, especially the electrical system wiring. General Motors recommends the following safety precautions:

- Every operator performing welding or cutting should wear goggles or masks designed for oxyacetylene work. Light from the oxyacetylene flame causes serious injury to the eyes, if unprotected.
- Use a friction lighter to light a welding torch. Never use matches, as doing so may result in burns, especially to the hand.
- Do not weld near or over cans, closed or empty. Flame from the welding torch can come into contact with fumes from the cans and result in an explosion.
- Never lay down a torch until the gases have been properly shut off.
- Hang torches only from hangers provided for that purpose.
- Keep the flame from coming into contact with hoses, regulators, cylinders, piping or any equipment. Failure to do so may result in fire.
- Do not set a hot piece of welding rod down where it can be picked up, stepped on or sat upon.
- When using a rod, bend the end over to eliminate any sharp points that may cause injury.
- To prevent leaks, make sure that regulators are firmly attached. Also take particular notice of the position of the thumbscrew and back it off until it spins with ease. When fastened to tanks or a line, regulators should be placed so that they do not interfere with valve operation in case of emergency.

Never use oil or grease on any part of the equipment or cylinders. Oil or grease, when combined with oxygen under pressure, will cause a violent explosion.

Additional welding precautions are:

- Before welding, remove or adequately shield any parts or components which could be damaged by excessive temperatures. Disconnect battery cables at the battery.
- Clean the area to be welded and the surrounding area of all frame-protective coating before welding.
- Place ground clamps as near as possible to the weld. This will eliminate stray current to vehicle components. Also use heavy gauge ground wire to a good building ground when welding.
- Open oxygen cylinder valves slowly so that the high-pressure gauge needle rises gradually, not with a jump. Continue to open the cylinder valve as far as it will go. Acetylene valves need only be opened to one-half turn.
- The hose's rubber covering burns easily. It is, therefore, important to keep the hose from coming into contact with hot, previously welded areas.
- After welding, allow parts to cool. Then carefully inspect wiring and electrical components for shortages or other damage which could draw excessive currents or cause an electrical system short when the battery is reconnected. Apply protective coating to areas from which coating was removed.

Body – Appendix I (cont'd)

Welding Guidelines and Precautions (cont'd)

Electrical System

See the Upfitter Integration Electrical Best Practices: Electrical System Precautions section.

CAUTION: To avoid damaging the OEM electrical system or components during welding procedures, GM recommends the following precautionary measures:

- Do not route welder electrical cables on, near or across any vehicle electrical wiring or components while welding is in progress.
- Remove or adequately shield any electrical or electronic components which can be damaged by excessive temperatures created by the welding operation.
- Protect all wiring and electrical components from damage that can be caused by welding flash (sparks).
- Make sure that the welder ground clamp is of an adequate size and placed as close as possible to the area being welded. Never use a vehicle suspension component as a welding ground point.
- Prior to any welding, disconnect all negative (ground) cable(s) from all battery(ies).
- Disable the air bag system as outlined in the “SIR Service Precautions” section of this manual.
- Disconnect any electrical/electronic computer modules located near the area to be welded. After welding is complete, carefully inspect any electrical wiring or components in the weld area for degradation or damage.

Body – Appendix II – General Fastener – Reference

Fastening To Thin Sheet Metal

Tapping screws have been a standard sheet metal attachment method for years. With the introduction of thinner gauges for cost and weight savings, new concerns became evident. Screws were stripping and loosening because the gauge now only allowed for 1/2 of a thread engagement. Extrusions did not help much because the extrusion wall, due to its thinness, would cut off instead of threading. The practical solution was the release of a new type of tapping screw, one which self extruded and rolled its own thread. This worked well but has shown itself to be somewhat operator sensitive. With the use of plant tooling at its present level of technology, this type of screw has had only moderate success.

Several other thin metal attachment fastening methods have been suggested. “Pop” rivets have always been a cost effective, fairly foolproof method of attaching joints that are in shear. The negative side is that the plants cannot seem to be able to install the parts effectively. Also loose mandrels are a common squeak and rattle complaint. Maintenance of the tool, proper pulling adjustment and periodic replacement of pulling jaws are usual reasons for poor performance of the tools.

The use of U-nuts, another often suggested method of attachment, is not always desirable. Clearance for the legs, installation slots or nearness to a flat edge, ergonomic considerations such as push-on effort, parts count increase, parts falling off or moving aside, are some of the problems encountered when using U-nuts in attachments. While the parts are used today, their shortcomings are carefully considered.

Various snap-ins, plastic as well as steel, do not function well in sheet metal joints, which are mostly in shear. Welding is a possibility, but leaves unsightly appearances. Even when weld attachments are done prior to paint, the weld depression is not acceptable on most visible surfaces.

An analysis of the root cause of the problem indicates that the correct solution is to thicken the attachment point. This can be done with the use of welded nuts (negatives are high cost of assembly, energy, labor, handling, poor tolerancing); pierce nuts installed in the stamping process (cost effective, but needs space for the physical dimensions of the part and installation tool clearances); the use of tapping plates (cost of energy, tolerances may be a concern); or the use of a snap-in type spring nut. The snap-in type spring nut, when used with a tapping screw, has been shown to be an effective, high-strength joint requiring little physical space, easily installed and relatively inexpensive.

Although tapping screws present some difficulties, their use cannot be totally eliminated. When used with metal-to-metal interfaces such as the snap-in nuts or other joint “thickeners” (i.e., tapping plates), they can effectively be a robustly designed attachment.

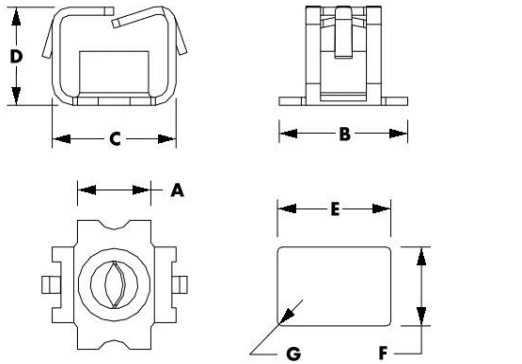
Body – Appendix II – General Fastener – Reference (cont'd)

Expansion Nuts – Box Style (Multi-Threaded)

Material:
Spring Steel per SAE J403 Grade 1050-1065

NOTES

- 4.2 sizes are recommended for Sheet Metal panels 0.5 – 5.0 mm thick with 4.2 X 1.41 Tapping Screws.
- DO NOT USE 4.2 or M6 NUTS IN PLASTIC PANELS. DO NOT USE M6 IN SOFT ALUMINUM OR MAGNESIUM.
- Multi-threaded Nuts are Preferred over Single impression threaded Nuts (i.e. Better Squeak and Rattle Performance).
- Typical Applications include: Fascia's, Tail lamps, Wheel Liners, Trim, Underbody panels, and Speakers.
- Push nuts, found on this catalog page, not recommended for installation in body shop. Covers up base metal and prevents base metal ELPO coverage.



RECOMMENDED HOLE DIMENSIONS
(AFTER ALL APPLIED FINISHES)

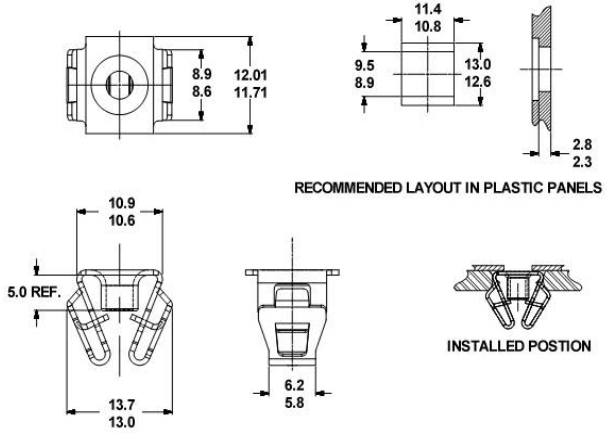
Thread / Pitch	Grip Range	Seal (Y/N)	A max	B max	C nom	D nom	E max	F max	G max
4.2 x 1.41	0.5 – 2.3	N	6.8	16.2	8.4	6.9	8.75	8.75	0.60
4.2 x 1.41	0.5 – 2.3	Y	6.8	16.2	8.4	6.9	8.75	8.75	0.60
4.2 x 1.41	1.4 – 5.0	N	14.0	24.5	10.8	9.9	16.2	11.2	1
M6 x 1.00	0.7 – 3.8	N	8.5	18.5	13.35	10.8	14.03	9.53	0.50
M6 x 1.00	0.7 – 2.0	Y	8.7	14.5	13.5	10.7	14.03	9.53	0.50

Expansion Nuts – Robotics Style (Multi-Threaded)

Material:
Spring Steel per SAE J403 Grade 1050-1065 Hardness R30N64-70

NOTES

- Recommended for Plastic panels with 4.2 X 1.41 Tapping Screws.
- Multi-threaded Nuts are Preferred over Single impression threaded Nuts (i.e. Better squeak and Rattle Performance).
- Typical Applications include: I/P Carriers, Fascia's, and Wheel Flares.
- If the panel thickness is greater than 2.80, then the step is required as shown below.



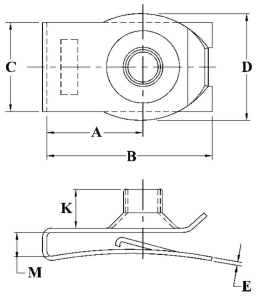
Body – Appendix II – General Fastener – Reference (cont'd)

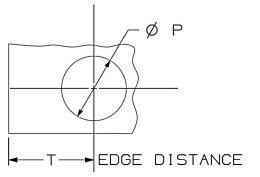
U-Nuts - Multithread

Material:
SAE J403 Grade 1050-1065
Hardness: <M6 HR30N 59.5 - 68.5, ≥M6 HRC 42 - 50

NOTES

- M10 & M8 parts are not recommended for use against plastic.
- Style I is preferred.
- Recommended for use with 4.2 X 1.41 screws.
- U-Nuts provide support to both sides of the mating panel and can be used on plastic or sheet panels.
- Multi-threaded Nuts are Preferred over Single impression and plastic nut members (Improved Squeak and Rattle Performance).
- Typical Applications include but are not limited to: interior and exterior trim panels to structure, consoles, instrument panel, fascia, tail lamp, and wheelhouse liners.





DETAIL FOR ASSEMBLY ON FLAT PANEL

Recommended Hole Dimensions

U-Nuts - Multithread (continued)

Size	Panel Thickness Range	PT	Throat Type	A Throat Depth	B Leg Length	C Leg Width 1	D Leg Width 2	E Stock Thickness		K Barrel Height		M Width At Fold		P Diameter		T Panel Edge
				+/- 0.5	+/- 0.5	+/- 0.5	+/- 0.5	max	min	max	min	max	min	max	min	+/- 0.5
4.2	0.5 - 2.0	Y	Style I	10.16	17.3	10.5	12.5	0.69	0.61	6.1	5.1	2.5	2.2	7.75	7.55	7.6
4.2	2.0 - 3.0	Y	Style I	9.6	16.8	"	"	"	"	"	"	3.5	3.2	"	"	"
4.2	0.65 – 3.8	Y	Style II	15.0	22.0	"	"	0.66	0.56	"	"	4.5	4.0	"	"	13.5
M6	0.8 - 4.0	N	Style I	13.5	23.5	12.5	14.5	0.90	0.70	6.5	5.5	5.2	3.2	10.1	9.9	12.0
"	0.8 - 4.0	Y	Style I	"	"	"	"	"	"	"	"	"	"	"	"	"
"	0.8 - 4.0	N	Style II	19.5	29.5	"	"	"	0.80	"	"	"	4.2	"	"	18.0
"	2.0 - 5.0	N	Style I	13.5	23.5	"	"	"	"	"	"	6.2	5.2	"	"	12.0
"	2.0 - 5.0	N	Style II	19.5	29.5	"	"	"	"	"	"	"	"	"	"	18.0
M8	0.8 - 4.0	N	Style I	14.5	25.0	14.2	17.0	1.10	1.00	9.0	7.5	5.2	3.2	11.5	11.3	13.0
"	0.8 - 4.0	N	Style II	21.0	31.5	"	"	"	"	"	"	"	4.2	"	"	19.5
"	2.0 - 5.0	N	Style I	14.5	25.0	"	"	"	"	"	"	6.2	5.2	"	"	13.0
"	2.0 - 5.0	N	Style II	21.0	31.5	"	"	"	"	"	"	"	"	"	"	19.5
M10	1.5 – 5.5	N	Style I	18.5	32.5	17.5	24.0	1.45	1.35	10.5	9.0	6.7	5.7	15.5	14.7	17.0
"	1.5 – 5.5	N	Style II	28.5	43.0	"	"	"	"	10.5	9.5	"	"	"	"	27.0
"	3.0 - 6.0	Y	Style I	18.5	32.5	17.5	23.9	"	"	10.2	9.2	7.7	6.6	15.6	15.1	15.6

PT = Prevailing torque, crimp type

Body – Appendix II – General Fastener – Reference (cont'd)

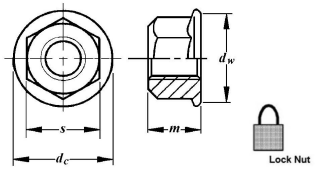
Hexagon Flange Nuts All-Metal Prevailing Torque

Material:
ISO 2320 (10)

NOTES

- For general applications, the Best Practice is to use All-Metal Prevailing Torque Nuts where prevailing torque nuts are required.
- All-metal prevailing torque (AMPT) nut usage guidelines:
  - Use AMPT nuts as a first choice, and use nylon ring/nylon patch nuts as an exception.
  - AMPT nuts can be used at higher temperatures than nylon ring/nylon patch nuts. Nylon ring/nylon patch nuts shall not be used when the nut temperature exceeds 120°C/248°F.
  - AMPT nuts can be used where higher prevailing on and off torques are required as compared to nylon ring/nylon patch nuts are required.
  - AMPT nuts should be used in safety critical joints where more warning of loosening is desired.
  - Do not use AMPT nuts on applications where thread galling will occur. Use nylon ring/nylon patch nuts on these applications.
- Nylon insert prevailing torque nuts should be used on an exception basis in the following applications:
  - Where consistent drive torques are required.
  - Where heavy or inconsistent paint build-up or overspray occur.
  - Where long rundowns (over 7 revolutions) occur.
  - In brake booster and steering column joints.
  - Where the externally threaded part has no finish.

Where temperature in service is greater than -70°C and less than 120°C.



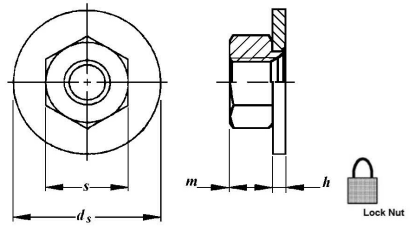
Thread / Pitch	s max	m max	d_c max	d_w min
M6 x 1.0	10.0	7.3	14.2	12.2
M8 x 1.25	13.0	9.4	17.9	15.8
M10 x 1.5	15.0	11.4	21.8	19.6
M12 x 1.75	18.0	13.8	26.0	23.8
M14 x 2.0	21.0	15.9	29.9	27.6
M16 x 2.0	24.0	18.3	34.5	31.9

AMPT Hexagon Nut and Washer Assemblies with Flat Washer

Material:
ISO2320 (10)

NOTES

- These nuts are recommended for use against soft surfaces, e.g. painted sheet, plastic etc.
- All-metal prevailing torque (AMPT) nut usage guidelines:
  - Use AMPT nuts as a first choice, and use nylon ring/nylon patch nuts as an exception
  - AMPT nuts can be used at higher temperatures than nylon ring/nylon patch nuts. Nylon ring/nylon patch nuts shall not be used when the nut temperature exceeds 120°C/248°F
  - AMPT nuts can be used where higher prevailing on and off torques are required as compared to nylon ring/nylon patch nuts are required.
  - AMPT nuts should be used in safety critical joints where more warning of loosening is desired.
- Do not use AMPT nuts on applications where thread galling will occur. Use nylon ring/nylon patch nuts on these applications.



Thread / Pitch	s max	m max	h max	d_s max
M6 x 1.0	10.0	5.7	2.00	19.0
M8 x 1.25	13.0	7.5	2.60	24.0

Body – Appendix II – General Fastener – Reference (cont'd)

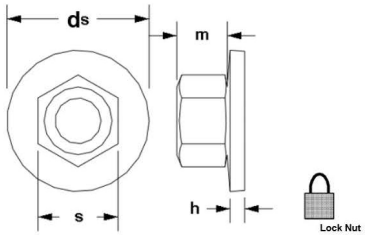
AMPT Hexagon Nut and Washer Assemblies with Conical Washer

Material:
ISO2320 (10)

NOTES

- All-metal prevailing torque (AMPT) nut usage guidelines:
  - Use AMPT nuts as a first choice, and use nylon ring/nylon patch nuts as an exception.
  - AMPT nuts can be used at higher temperatures than nylon ring/nylon patch nuts. Nylon ring/nylon patch nuts shall not be used when the nut temperature exceeds 120°C/248°F.
  - AMPT nuts can be used where higher prevailing on and off torques are required as compared to nylon ring/nylon patch nuts are required.
  - AMPT nuts should be used in safety critical joints where more warning of loosening is desired.
  - Do not use AMPT nuts on applications where thread galling will occur. Use nylon ring/nylon patch nuts on these applications.

These nuts are not recommended for use against soft surfaces, e.g. plastic etc. Use a nut with flat washer instead.

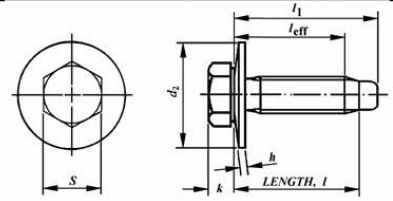


Thread / Pitch	s hex	m max	d_s max	h max
M6 x 1.0	10.0	5.70	19.0	2.00
M8 x 1.25	13.0	7.50	19.0	2.60
M8 x 1.25	13.0	7.50	24.0	2.60
M10 x 1.5	15.0	9.30	28.0	3.05
M12 x 1.75	18.0	12.00	28.0	3.20
M14 x 2.0	21.0	14.10	32.0	3.45
M14 x 2.0	21.0	14.10	40.0	3.45
M16 x 2.0	24.0	16.40	36.0	4.05
M16 x 2.0	24.0	16.40	40.0	4.05

Hex Screw and Washer Assemblies with Conical Washer and M-Point

NOTES

- Hex flange bolts are recommended for use in most applications.
- These fasteners should only be used against hard surfaces (e.g. steel) and when needed to cover clearance holes.
- These fasteners should not be used against soft surfaces (e.g. plastic, aluminum).



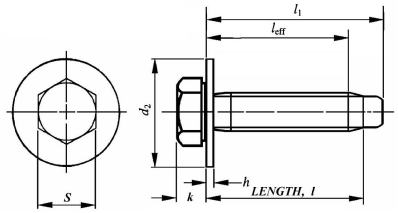
Thread		M6			M8			M10			M12		
P	Pitch	1			1.25			1.5			1.75		
s	Hex	10			13			15			18		
k	max	4.15			5.45			6.58			7.68		
h	max	2.12			2.63			3.15			3.55		
d_2	max	17			24			28			35		
l		l_1	l_{eff}		l_1	l_{eff}		l_1	l_{eff}		l_1	l_{eff}	
nom		max	min		max	min		max	min		max	Min	
12		15.0	9.55										
16		19.0	13.55		20.05	13.05							
20		23.0	17.55		24.05	17.05		24.8	16.45				
25		28.0	22.55		29.05	22.05		29.8	21.45		30.8	20.85	
30		33.0	27.55		34.05	27.05		34.8	26.45		35.8	25.85	
35					39.05	32.05		39.8	31.45		40.8	30.85	
40					44.05	37.05		44.8	36.45		45.8	35.85	
45					49.05	42.05		49.8	41.45		50.8	40.85	
50					54.05	47.05		54.8	46.45		55.8	45.85	
55					59.15	51.95		59.9	51.35		60.9	50.75	
60											65.9	55.75	
65											70.9	60.75	
70								75.05	66.50		75.9	65.75	
80								85.1	76.35		85.9	75.75	
85											90.9	80.75	11570800

Body – Appendix II – General Fastener – Reference (cont'd)

Hex Screw and Washer Assemblies with Flat Washer and M-Point

NOTES

- This fastener is recommended for use against soft surfaces. (e.g. plastic, aluminum)
- For screws with washers with d2 of 24.00mm the recommended maximum clearance hole is 15mm.
- Hex flange bolts are recommended for use in most applications.

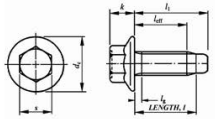


Thread / Pitch	Property Class	l nom	l_1 max	l_{eff} min	S max	k max	h max	d_2 max
M6 x 1.0	8.8	12.0	15.0	9.55	10.0	4.15	1.68	17.00
M6 x 1.0	8.8	16.0	19.0	13.55	10.0	4.15	1.68	17.00
M6 x 1.0	8.8	16.0	19.0	13.55	10.0	4.15	2.30	24.00
M6 x 1.0	8.8	20.0	23.0	17.55	10.0	4.15	1.68	17.00
M6 x 1.0	8.8	20.0	23.0	17.55	10.0	4.15	2.30	24.00
M6 x 1.0	8.8	25.0	28.0	22.55	10.0	4.15	1.68	17.00
M6 x 1.0	8.8	25.0	28.0	22.55	10.0	4.15	2.30	24.00
M6 x 1.0	8.8	30.0	33.0	27.55	10.0	4.15	1.68	17.00
M6 x 1.0	8.8	30.0	33.0	27.55	10.0	4.15	2.30	24.00
M6 x 1.0	8.8	35.0	38.0	32.55	10.0	4.15	1.68	17.00
M6 x 1.0	8.8	35.0	38.0	32.55	10.0	4.15	2.30	24.00
M6 x 1.0	8.8	40.0	43.0	37.55	10.0	4.15	1.68	17.00
M6 x 1.0	8.8	40.0	43.0	37.55	10.0	4.15	2.30	24.00
M6 x 1.0	8.8	45.0	48.0	42.55	10.0	4.15	1.68	17.00
M8 x 1.25	8.8	26.6	30.7	23.70	13.0	5.45	2.09	24.0
M8 x 1.25	8.8	30.0	34.05	27.05	13.0	5.45	2.63	32.0
M8 x 1.25	9.8	36.45	40.5	32.50	13.0	5.50	2.80	32.0
M8 x 1.25	10.9	39.95	44.0	37.00	13.0	6.00	2.30	24.0
M8 x 1.25	8.8	55.0	59.05	52.05	13.0	5.45	2.20	24.0

GENERAL USE FASTENERS:
BOLTS AND SCREWS:
Heavy Hexagon Flange Bolts with M-Point, Full Body, Radius Head (Acorn)

NOTES

- Parts above the continuous red thick stepped line are threaded to the head. For M6, M8, and M10 Applications use Heavy Hexagon Flange Bolts with M-Point, Full Body, Radius Head (Acorn).



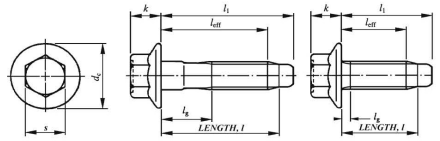
Thread		M6					M8					M10				
P		1.0					1.25					1.5				
s	Hex	10					13					15				
k	max	6.6					8.1					10.4				
d_c	max	14.2					18					22.3				
l		l	l_1	l_{eff}	l_g		l	l_1	l_{eff}	l_g		l	l_1	l_{eff}	l_g	
(ref)		nom	max	min	max		nom	max	min	max		nom	max	min	max	
10		7.65	10.65	5.2	1.5											
13		10.65	13.65	8.2	1.5											
16		13.65	16.65	11.2	1.5											
20		17.65	20.65	15.2	1.5		16.65	20.70	13.7	1.9		15.85	20.65	12.3	2.2	
25		22.65	25.65	20.2	2.5		21.65	25.70	18.7	1.9		20.85	25.65	17.3	2.2	
30		27.65	30.65	25.2	2.5		26.65	30.70	23.7	3.1		25.85	30.65	22.3	2.2	
35		32.65	35.65	30.2	12.5		31.65	35.70	28.7	3.1		30.85	35.65	27.3	3.8	
40		37.65	40.65	35.2	17.5		36.65	40.70	33.7	12.0		35.85	40.65	32.3	3.8	
45		42.65	45.65	40.2	22.5		41.65	45.70	38.7	17.0		40.85	45.65	37.3	11.5	
50		47.65	50.65	45.2	27.5		46.65	50.70	43.7	22.0		45.85	50.65	42.3	16.5	
55		52.65	55.75	50.1	32.5		51.65	55.80	48.6	27.0		50.85	55.75	47.2	21.5	
60		57.65	60.75	55.1	37.5		56.65	60.80	53.6	32.0		55.85	60.75	52.2	26.5	
65		62.65	65.75	60.1	32.5		61.65	65.80	58.6	37.0		60.85	65.75	57.2	31.5	
70		67.65	70.75	65.1	47.5		66.65	70.80	63.6	42.0		65.85	70.75	62.2	36.5	
75		72.65	75.75	70.1	42.5		71.65	75.80	68.6	45.0		70.85	75.75	67.2	41.5	
80		77.65	80.75	75.1	57.5		76.65	80.80	73.6	52.0		75.85	80.75	72.2	46.5	
85		82.65	85.75	80.1	52.5		80.00	84.15	77.0	52.0		80.85	85.75	77.2	51.5	
90		87.65	90.75	85.1	67.5		86.65	90.80	83.6	62.0		85.85	90.75	82.2	56.5	
95		91.85	94.95	89.3	62.6		91.65	95.80	88.6	67.0		90.85	95.75	87.2	61.5	
100							96.65	100.80	93.6	72.0		95.85	100.75	92.2	66.5	
105							100.85	105.00	97.8	76.2		100.85	105.75	97.2	71.5	
110		107.65	110.75	105.1	87.5		105.00	109.15	101.9	83.0		105.85	110.75	102.2	76.5	
115		112.65	115.75	110.1	87.0		111.65	115.80	108.6	87.0		110.85	115.75	107.2	81.5	
120							116.65	120.80	113.6	92.0		115.85	120.75	112.2	86.5	
125							122.65	126.80	119.6	98.0		120.85	125.75	117.2	91.5	

Body – Appendix II – General Fastener – Reference (cont'd)

Heavy Hexagon Bolts with Flange and M-Point M12, M14, M16

NOTES

- Parts above the continuous red thick stepped line are threaded to the head. For M12, M14, and M16 Applications Use Heavy Hexagon Bolts with Flange and M-Point.

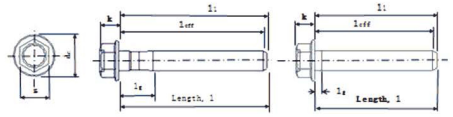


Thread		M12			M14				M16			
P	Pitch	1.75			2				2			
s	Hex	18			21				24			
k	max	11.8			13.7				15.4			
d_c	max	26.6			30.5				35			
l		l_1	l_{eff}	l_g	l_1	l_{eff}	l_g		l_1	l_{eff}	l_g	
nom		max	min	max	max	min	max		max	min	max	
25		30.8	20.85	2.6								
30		35.8	25.85	4.4	36.58	25.35	3					
35		40.8	30.85	4.4	41.58	30.35	5		42.25	30.35	3	
40		45.8	35.85	4.4	46.58	35.35	5		47.25	35.35	5	
45		50.8	40.85	4.4	51.58	40.35	5		52.25	40.35	5	
50		55.8	45.85	4.4	56.58	45.35	5		57.25	45.35	5	
55		60.9	50.75	4.4	61.68	50.25	5		62.35	50.25	5	
60		65.9	55.75	4.4	66.68	55.25	5		67.35	55.25	5	
65		70.9	60.75	4.4	71.68	60.25	5		72.35	60.25	5	
70		75.9	65.75	21.0	76.68	65.25	5		77.35	65.25	5	
75		80.9	70.75	26.0	81.68	70.25	5		82.35	70.25	5	
80		85.9	75.75	31.0	86.68	75.25	27		87.35	75.25	5	
85		90.9	80.75	36.0	91.68	80.25	32		92.35	80.25	5	
90		95.9	85.75	41.0	96.68	85.25	37		97.35	85.25	33	
95		100.9	90.75	46.0	101.68	90.25	42		102.35	90.25	38	
100		105.9	95.75	51.0	106.68	95.25	47		107.35	95.25	43	
105		110.9	100.75	56.0	111.68	100.25	52		112.35	100.25	48	
110		115.9	105.75	61.0	116.68	105.25	57		117.35	105.25	53	
115		120.9	110.75	66.0	121.68	110.25	62		122.35	110.25	58	
120		125.9	115.75	71.0	126.68	115.25	67		127.35	115.25	63	
125		130.9	120.75	76.0	131.68	120.25	72		132.35	120.25	68	
130		135.9	125.75	81.0	136.68	125.25	77		137.35	125.25	73	
135		140.9	130.75	86.0	141.68	130.25	82		142.35	130.25	78	
140		145.9	135.75	91.0	146.68	135.25	87		147.35	135.25	83	
145					151.68	140.25	105					
150		155.9	145.75	71.0	156.68	145.25	97		157.35	145.25	93	
155		160.9	150.75	120.0								
160		165.9	155.75	91.0					167.35	155.25	103	

Heavy Hexagon Bolts with Flange and Header Point

NOTES

- **Header point bolts are intended for use in hand starting applications only.**
- Parts above the continuous red thick stepped line are threaded to the head.
- Reduced shank type only below the dashed line. If no dashed line on a diameter, parts below red line are also reduced shank.



Thread		M10			M12				M14				M16		
P	Pitch	1.5			1.75				2				2		
S	Hex	15			18				21				24		
K	max	10.4			11.8				13.7				15.4		
d_c	max	22.3			26.6				30.5				35		
l		l_1	l_{eff}	l_g	l_1	l_{eff}	l_g		l_1	l_{eff}	l_g		l_1	l_{eff}	l_g
nom		max	min	max	max	min	max		max	min	max		max	min	max
16		16.4	13.35	2.2											
20		20.4	17.35	2.2											
25		25.4	22.35	3.8	25.4	22.18	4.4								
30		30.4	27.35	3.8	30.4	26.98	4.4		30.4	25.6	3				
35		35.5	32.25	3.8	35.8	31.58	4.4		35.8	30.2	5		35.8	30.2	3
40		40.8	37.25	3.8	40.8	36.58	4.4		40.8	35.2	5		40.8	35.2	5
45		45.8	42.25	3.8	45.8	40.7	4.4		45.8	40.2	5		45.8	40.2	5
50		50.8	47.25	3.8	50.8	45.7	4.4		50.8	45.2	5		50.8	45.2	5
55		56.0	52.15	3.8	56.0	50.5	4.4		56.0	50.0	5		56.0	50.0	5
60		61.0	57.15	3.8	61.0	55.5	4.4		61.0	55.0	5		61.0	55.0	5
65		66.0	62.15	11.5	66.0	60.5	4.4		66.0	60.0	5		66.0	60.0	5
70		71.0	67.15	16.5	71.0	65.5	4.4		71.0	65.0	5		71.0	65.0	5
75		76.0	72.15	21.5	76.0	72.5	4.4		76.0	70.0	5		76.0	70.0	5
80		81.0	77.15	26.5	81.0	75.5	4.4		81.0	75.0	5		81.0	75.0	5
85		86.1	82.05	31.5	86.1	80.4	4.4		86.1	79.9	5		86.1	79.9	5
90		91.1	87.05	36.5	91.1	85.4	21		91.1	84.9	5		91.1	84.9	5
95		96.1	92.05	41.5	96.1	90.4	26		96.1	89.9	5		96.1	89.9	5
100		101.1	97.05	46.5	101.1	95.4	31		101.1	94.9	27		101.1	94.9	5
105		106.1	102.05	51.5	106.1	100.4	36		106.1	99.9	32		106.1	99.9	5
110		111.1	107.05	56.5	111.1	105.4	41		111.1	104.9	37		111.1	104.9	33
115		116.1	112.05	61.5	116.1	110.4	46		116.1	109.9	42		116.1	109.9	38
120		121.1	117.05	66.5	121.1	115.4	51		121.1	114.9	47		121.1	114.9	43
125		126.3	121.95	71.5	126.3	120.2	56		126.3	119.7	52		126.3	119.7	48
130					131.3	125.2	61		131.3	124.7	57		131.3	124.7	53
135					136.3	130.2	66		136.3	129.7	62		136.3	129.7	58
140					141.3	135.2	71		141.3	134.7	67		141.3	134.7	63
150									151.3	144.7	77		151.3	144.7	73
160													161.3	154.7	83

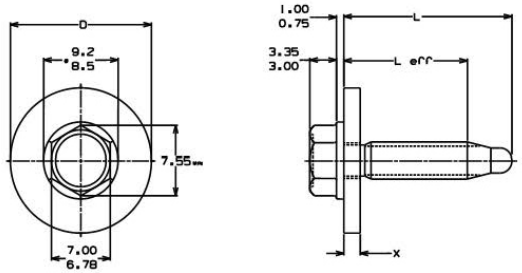
Body – Appendix II – General Fastener – Reference (cont'd)

M4.2 Hex Washer Head Tapping Screw Assembly with Flat Washer BR Point

Material:
ISO 2702

NOTES

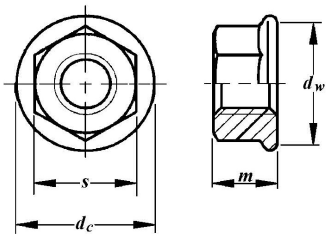
- To be used with Multi-Threaded U-nuts & Expansion Type Nuts.
- Fastening directly into plastic is not a recommended practice for a robust attachment.
- The recommended clearance holes are 5.0 mm diameter for Regular series washers, and 8.0mm diameter for Wide series washers.
- Not to be used for structural attachments.



Thread / Pitch	Series	D		X		L			L eff
		min	max	min	max	nom	min	max	min
M4.2 x 1.41	Regular	12.07	12.50	1.0	1.4	13	12.2	13.8	7.2
M4.2 x 1.41	Regular	12.07	12.50	1.0	1.4	16	15.2	16.8	10.2
M4.2 x 1.41	Regular	12.07	12.50	1.0	1.4	20	19.2	20.8	14.2
M4.2 x 1.41	Regular	12.07	12.50	1.0	1.4	25	24.2	25.8	19.2
M4.2 x 1.41	Regular	12.07	12.50	1.0	1.4	30	28.7	31.3	23.7
M4.2 x 1.41	Regular	12.07	12.50	1.0	1.4	35	33.7	36.3	28.7
M4.2 x 1.41	Wide	16.57	17.00	1.6	2.3	16	15.2	16.8	10.2
M4.2 x 1.41	Wide	16.57	17.00	1.6	2.3	20	19.2	20.8	14.2
M4.2 x 1.41	Wide	16.57	17.00	1.6	2.3	25	24.2	25.8	19.2
M4.2 x 1.41	Wide	16.57	17.00	1.6	2.3	30	28.7	31.3	23.7

Hexagon Nuts with Flange

Material:
ISO 898-2 (8 ≤M8, 10 ≥M10)



Thread / Pitch	s hex	d_c max	d_w min	m max
M6 x 1.00	10.0	14.2	12.2	6.0
M8 x 1.25	13.0	17.9	15.8	8.0
M10 x 1.50	15.0	21.8	19.6	10.0
M12 x 1.75	18.0	26.0	23.8	12.0
M14 x 2.00	21.0	29.9	27.6	14.0

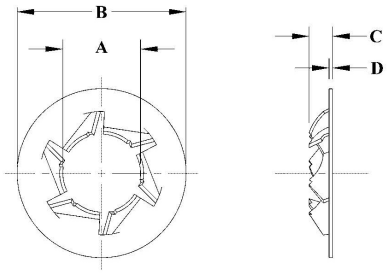
Body – Appendix II – General Fastener – Reference (cont'd)

RETAINERS:

Retainer

Material:
SAE J403 Grade 1050 min

NOTES	• Generally used to temporarily retain fasteners during shipping and assembly.



Thread / Pitch	A Inside Diameter		B Outside Diameter		C Overall Thickness		D Stock Thickness		Purpose
	max	min	max	min	max	min	max	min	
M6 x 1.00	5.40	5.10	12.95	12.45	2.43	1.93	0.270	0.230	General
M6 x 1.00	5.40	5.10	12.95	12.45	2.43	1.93	0.270	0.230	Grounding
M8 x 1.25	7.29	6.99	16.15	15.65	2.35	1.85	0.355	0.305	General
M10 x 1.50	9.25	8.95	20.05	19.55	2.78	2.02	0.418	0.342	General
M10 x 1.50	9.25	8.95	20.05	19.55	2.78	2.02	0.418	0.342	Appearance
M12 x 1.75	10.95	10.65	21.65	21.15	2.98	2.22	0.418	0.342	General
M14 x 1.5	13.25	12.75	25.12	24.86	3.50	3.00	0.430	0.380	General

Body – Appendix III – Design Principles To Eliminate Squeaks & Rattles – General Principles

SQUEAKS & RATTLES
Squeaks and Rattles are Unwanted Sounds that are annoying, irritating, and/or disturbing — sounds without agreeable quality. Some examples of causes are:
HITTING
SLIDING
SLIP-STICK CONDITION
VIBRATING
To prevent unwanted sounds follow one or more of the
"KISS"
principles for all operating positions and conditions.
Klearance
Parts must never touch under variations in the following conditions:
Environmental – Temperature, humidity
Operating – Severe road inputs, various engine operating conditions
Manufacturing – Process variation, manufacturing tolerance
Isolate
Close or touching parts must be separated with isolation materials.
Examples are:
Foams, felts, sleeves, rubber bumpers, heat shrink tubing, nylon, spacers, tapes (cloth, urethane, mylar), weld through sealers, lubricants, coatings, flocking, etc.
Structure
Parts and systems must be designed with adequate stiffness and strength to hold their own shape and avoid resonant vibration.
Examples are:
Cross car beams, ribbing, material thickness, material selection, composites, gussets, I-beams, channel sections, box sections, etc.
Secure
Parts must be fastened to prevent relative motion.
Examples are:
Welds, heat stakes, clips, rivets, bolts, tapes, adhesives, crush ribs, spring locks, etc.

Squeaks and rattles (S&R) are unwanted sounds that are without agreeable quality. Some examples of causes are: hitting, sliding (slip-stick condition), vibrating.

To prevent unwanted sounds follow one or more of the four principles below for all operating positions and conditions.

Klearance - Parts must never touch under variations in the following conditions: environmental - temperature, humidity operating -severe road inputs, various engine operating conditions manufacturing - process variation, manufacturing tolerance

Isolate - Close or touching parts must be separated with isolation materials.
Examples include foams, felts, sleeves, rubber bumpers, heat shrink tubing, nylon spacers, tapes (cloth, urethane, mylar), weld through sealers, lubricants, coatings, flocking.

Structure - Parts and systems must be designed with adequate stiffness, strength, and damping to hold their own shape and avoid resonant vibration.
Examples are cross-car beams, ribbing, material thickness, material selection, composites, gussets, I-beams, channel sections, box sections.

Secure - Parts must be fastened to prevent relative motion.
Examples are welds, heat stakes, clips, rivets, bolts, tapes, adhesives, crush ribs, spring locks.

Body – Appendix III – Design Principles To Eliminate Squeaks & Rattles – Instrument Panel

Klearance (Clearance)

1. There shall be a minimum of 1.5mm design clearance between the cluster trim plate and the gauge cluster assembly. Isolation is required to maintain this clearance; rubber tipped standoffs is one method (reference "Isolation" item #3 below).

2. There shall be a minimum of 5mm design clearance between the cluster trim plate and the steering column or isolation is required. These clearances are to be maintained for all positions of the steering column.

3. There shall be clearance for keys in the key cylinder to allow for a 140mm long keyring/fob assembly swinging from the key cylinder with the column in all positions, or isolation is required.

4. There shall be 5mm minimum design gap between the trim plate and the side door trim.

5. For flush fit style trim plates, there shall be 0.5mm minimum design clearance between the trim plate and the perimeter of the radio/HVAC control head. It is recommended to attach the trim plate to the radio head and HVAC control head to minimize the affect of variation, minimize relative motion, and maintain the clearance.

6. A minimum of 0.5mm design clearance shall be maintained between the trim plate and it"s adjacent, non-overlapping I/P mounted trim panel (e.g.: knee bolster, accessory power point/outlet door, top pad/close-out, etc). A minimum 3mm wide surface should be placed at the interface of the two panels to allow application of isolation material if it is found to be needed.

Isolation

1. To prevent material itch/wear at trim to carrier substrate and trim to trim interfaces, the use ofolefin based plastics (e.g. polypropylene, unpainted TPO or polyethylene) for trim plate substrate materials is recommended. This is particularly important with chromed trim pieces on the trim plate. When using all other material types in combination with styrenic (e.g. ABS,PC+ABS, dylark, etc) or painted I/P carriers , isolation is required (e.g.: using rubber tipped clip standoffs, felt along edges, UHMW tape, paint masking, etc) at trim to trim and trim to carrier substrate contact points, including locators. ABS and PC/ABS is not recommended. Isolation has been found to be operator sensitive and prohibitively costly, proper choice of materials is a much more economical and robust.

2. For soft surface I/P carriers, the use of unpainted TPO or O"Sullivan WR-P4NAST "soft feel" vinyl skin is recommended if trim plates are designed with no clearance to the carrier skin. If unpainted TPO or O"Sullivan WR-P4NAST "soft feel" skin is not used, or the trim plates are not made of polypropylene or unpainted TPO, then isolation is required. An aggressive or heavy type grain applied to the trim at the interface to the soft surface of the I/P carrier can sometimes be used in place of an isolation material. It is recommended to always leave a flat surface at the perimeter of the trim plate backside to allow application of isolators if isolators are found to be needed.

3. For picture frame style trim plates, the use of rubber isolators between the trim plate and components (e.g.: cluster assembly, radio, HVAC control head, headlamp switch, etc.) is required. A minimum of 6 rubber isolators is required. The maximum distance between isolators shall not exceed 150mm and are required around the entire perimeter of the trim plate opening. Ideally, the standoffs should intersect the adjoining component at a 90 degree angle. The standoffs onto which the rubber isolators mount shall have flat tips with an area exceeding 4 square millimeters to prevent the trim plate standoff from wearing through the rubber tip isolators.

4. For chrome plated trim pieces located on the I/P trim plate, prevent or minimize chrome plating in the hidden portions of the trim to reduce the chance of material itch noises. This includes the attachments and locators for the chrome trim pieces.

Body – Appendix III – Design Principles To Eliminate Squeaks & Rattles – Instrument Panel, cont.

Structure

1. Stiffening ribs on the backside of the trim panels are recommended to maintain the trim panel design intent shape and clearances after trim installation. This can also be achieved by crowning the trim plate during molding process.

Secure

1. Option delete plates shall be secured in all six degrees of freedom using preloaded attachments (e.g.: crush ribs, retainers with angled back cuts, etc.) to prevent relative motion between the option delete plate and the trim plate.

2. Switches attached to I/P trim plates shall utilize preloaded attachments (e.g.: rubber bumpers, preloaded snap fits, etc.) to prevent relative motion between the switch and the trim plate.

3. When using clips, screws are recommended in hidden areas, such as along the bottom edge of the trim plate, to minimize relative motion between the trim plate and carrier. Do not thread screws directly into plastic bosses. For trim plates not made of unpainted olefin plastics (e.g. polypropylene or TPO), avoid using post style, non-attaching locators. These locators itch against the I/P carrier resulting in the need for isolators. Avoid cantilevered sections of trim secured by butting into an adjacent portion of the I/P. Avoid bayonet style clip attachments.

4. 4.2 diameter trim screw fasteners shall have a minimum dynamic torque specification of D2.5 Nm +/-0.5Nm, S1Nm Min when driven into metal nut members. Where screws are used, incorporate multi-threaded barrel expansion nuts. Screws with flat washer assemblies should be used when mating to plastic to distribute bearing surface clamping forces and prevent deformation or cracking of the mating plastic. Fastening directly into plastic is not preferred. Do not use sheet metal tapping screw thread profiles into plastic bosses, use only thread forming screws for plastics.

5. For vehicles designed for truck usage schedules, the use of a minimum of four screws, combined with U-base self locating clips to fasten the cluster trim plate to the I/P carrier is recommended. It is recommended that all other trim plates utilize a minimum of one screw attachment.

6. For trim plates utilizing screw attachments, place the non-retaining post style locators as close as possible to the screw attachment points to prevent them from itching against the I/P carrier. This helps prevent the need for isolators. Minimize the number of these locators. For locators made of polypropylene and unpainted TPO, utilize crush ribs on the locator for an interference fit to the mating part to avoid buzzing noises at the interface. Also, locators shall extend beyond the attachment so that the locators engage the I/P first.

7. Fastener spacing of 150mm maximum is recommended.

8. When installing chrome trim on I/P trim plates, locators should also function as attaching points to avoid locator to trim plate noise. Also, for I/P trim plates not made of polypropylene or unpainted TPO, any chromed trim pieces attached to the I/P trim plate shall be attached with glue or two sided adhesive tape. The glue and tape prevent relative motion between the I/P trim plate and the chrome trim. Make sure the surface on which the glue will be adhering has some profile (not smooth) to allow the glue to stay adhered. If glue cannot be utilized, isolation is required.

9. Items secured to the trim plates shall be attached using methods that will prevent relative motion between the attachments and trim plates or isolation is required.

10. Storage pocket rubber inserts shall be secured to the trim plate to prevent rattles due to relative motion between the two.

Body – Appendix III – Electrical

Klearance (Clearance)

1. Determine wiring harness bundle size, path, and breakouts. This will ensure that adequate "real estate" is provided to accommodate the wiring harness.

2. Route the wiring harness as straight as possible minimizing bends, twists, etc.

3. Provide clearance for wiring and connectors between moving door parts and glass (all positions).

4. For specific applications, fasteners can provide clearance.

5. The direction and location of breakouts is critical. Minimize the distance between breakout location and component to 150mm. If the breakout exceeds 150mm, additional pre-loaded attachments are required.

Isolation

1. Service loops must be isolated and/or secured. If the service loop splits into multiple branches, each branch needs to be isolated.

2. The recommended wiring cover material in the I/P, console, side doors, headliner, package shelf and seats is cloth tape (0.80 mm thick stitch-bonded PET non-woven tape). The recommendation at all other interior locations is 0.27-mm thick woven polyester cloth tape.

3. If possible, keep the length of service loops to a maximum of 150mm. For all service loops the wiring shall be tape wrapped the entire length.

Structure

1. To maintain the wiring harness position, the mounting surface must ensure three-dimensional integrity. Additional parts are needed for dimensional integrity at transitions-(e.g., molded plastic guides, channels or possible steel rod inserts).

Secure

1. The wiring harness must be securely retained in position with pre-loaded single-position clips. Maximum spacing of attachments is 150 mm in the interior (including the door inner and liftgate) and 200 mm under hood, underbody, or any interior (non-door) harness wrapped with 0.80 mm thick stitch-bonded PET non-woven tape. When the harness changes direction, attachments are required as close as possible to the transition.

2. The design must ensure operator visibility of attachments and specify breakout positions and directions.

3. Plastic convoluted conduit has a propensity to rattle. It should be avoided whenever possible. If conduit must be used recognize that:
A) Wiring can rattle within the conduit. Choose the proper size to prevent wiring from moving or provide some type of filler material (e.g., foam).
B) Conduit can rub or vibrate against a harder surface or itself. It must be secured every 150 mm (more often when changing directions) unless secured by other means (e.g. carpet, etc.). Isolation or clearance must be provided at any remaining contact points.

4. The edge over metal clip is not recommended.

5. The characteristics of preferred attachments are positive retention feedback to the operator, have insertion forces meeting ergonomic requirements and a pre-load mechanism to avoid rattles in the inserted position. Some fasteners are sensitive to panel thickness therefore the length of the fastener must vary dependent upon the panel surface. The fastener must be serviceable to avoid removal damage.

Body – Appendix III – Electrical, cont.

6. The "fir tree" or "christmas tree" fastener can be used on the chassis, powertrain and under carpet inside the vehicle. When used, the fastener must meet ergonomic insertion force requirements which will help to ensure engagement of the preload feature.

7. Avoid using attachments without preload mechanisms.

8. Adjustable fasteners should be sized appropriately for the diameter of the wiring bundle. Tie straps are not recommended for small bundles. If a tie strap is used, the tail must be cut off. When a tie strap is not used, a fastener that preloads the wire bundle must be selected. Whenever possible, a female connector should be part of component assembly.

10. If the mating connector cannot be part of the assembly, then it must be securely retained to a structural part.

11. Unused connectors must be positively located. Use a dummy connector or tape the unused connector to the harness.

12. "Zero" clearance between connector mates is required to prevent rattles. Crush ribs, spring locks, etc. are means to achieve "Zero" clearance.

13. Terminal Position Assurance (TPA) and/or Connector Position Assurance (CPA) fasteners must be free of movement when engaged regardless of the number of unused cavities.

14. Do not use adhesive tape or "two sided sticky-tape" to secure wire harnesses. Adhesive tapes tend to lose strength at extreme temperatures.

15. Connectors must be adequately secured with pre-loaded attachments, or be isolated as required, to prevent rocking and any contact with the substrate.

Body – Appendix III – Interior Trim

- Locator tab must be short and strong so they will not break off during assembly.
- Look out for molding rattle against weld flange, body panels or against each other.
- Large trim panel requires more locator tabs and securing points for securing because of low stiffness. Or else, use foam insulation to preload panel.
- Trim should be separated by space (at least 2.5mm) or by fasteners.
- Overlapping trim piece should use foam or fastener for insulation.
- All convenience equipment (such as ash trays, storage bucket, etc.) should be attached and secured from rattling.
- Utilize stand-off ribs to create pre-load or clearance between surfaces.
- Vinyl and leather trim should not rub against other components.
- Pre-load trim around manual window crank to prevent rattling of crank.
- All trim pieces should have good clearance from door trims and window glass (at least 5mm).
- Clearance of A-pillar molding to windshield should be 5mm.
- Headliner must be secured and have sufficient gap (5mm) from windshield to prevent itching, vibration, and rattling.
- Fasteners must be stronger than the thread to prevent threading.
- Provide preload to interfacing parts to prevent potential vibrations.
- Support for speaker attachment must be rigid.
- Use foam to separate surfaces that are in close proximity.
- Speaker grill and the attachment area must be rigid to accommodate for more powerful and heavy speakers.
- Trim plates should have tight tolerances to ensure clearance or interface fit.
- Provide insulating material (foam or anti-itch tape) between surfaces in proximity from rattling or vibration.
- Avoid plastic bosses in the injection molded panel and trim plate in structural application since the plastic will creep under load.
- When two vinyl or plastic panels are requried to be attached together – a concealed joint line should be designed.
- Snap-in assembly should only be used for components that are not frequently removed in order to preserve the designed tightness.
- Increase trim's tapered corner (for decreased rib length) to prevent squeak or itch.
- Trim should not fucntion as direct loading support.
- Attachment fastener should be in a tension state with the attaching surface.
- Trim that are designed to preload against each other may lose its tension because of temperature cycling.
- Design with common parts, common method and specification for assembly.
- Beware of trim's rib locations relative to parts in near proximity.
- Locate retractor behind trim (with good separation) and away from the ears location if possible for better sound insulation.

Body – Appendix III – Body & Exterior Trim

- Reduce or avoid metal maintenance access panel because of the possible loss, loose or missing screws during assembly.
- Component should not be mounted in the center of large panels that have low structural stiffness.
- Component should be mounted to flanges, at corners, ribs or beads – but need to consider fatigue from stress concentration and component contact.
- Utilize foam as an insulator or a spacer in hollow space to prevent oil canning sound.
- Instead of snap fit to join two plastic parts, consider machine screw fastener with U-nut or snap-in for better retention.
- Most of rattling can be eliminated if the vehicle body or the mounting bracket is stiff against bending and twisting.
- Avoid multiple and overlapping trim pieces due to itch and difficult alignment.
- Window moldings and external trims must be made of materials that will not itch when rubbed against body surfaces (check by rubbing sample against painted panel).

Body – Appendix III – Seats

Klearance (Clearance)

1. Maintain minimum clearance of 15 mm between console and all parts of seat (seat cushion, seat back, armrest, track, and track cover) to avoid squeaks and itches in all seat positions, including 95th percentile occupant. If clearance cannot be maintained, isolation is required.

2. Maintain minimum clearance of 10 mm between trim panels and all parts of seat (seat cushion, seat back, armrest, track and track cover) to avoid squeaks and itches in all seat positions, including 95th percentile occupant. If clearance cannot be maintained, isolation is required.

3. Maintain minimum clearance of 20 mm between door trim panels and all parts of seat (seat cushion, seat back, armrest, track and track cover) to avoid squeaks and itches in all seat positions, including 95th percentile occupant. If clearance cannot be maintained, isolation is required.

4. For vinyl or leather seats, maintain clearance of 5mm between side track shields and seat cushion in all seat positions during all static and dynamic conditions, including 95th percentile occupant. If clearance cannot be maintained, isolation is required.

5. Except at attaching points, sidetrack shields shall maintain 5mm of clearance to seat base tracks and any attaching components. If clearance cannot be maintained, isolation is required.

6. If an under seat storage bin is used, a preloading fit shall be designed into the track interfaces. This will minimize rattles within the track system. In addition, to reduce track wear, the track system should incorporate a self-lubricating material and/or utilize a bearing type system.

7. All levers and related components in the adjuster mechanism shall have a minimum of 10mm clearance to floor and other components (including side track shields). Electric motors must also maintain a 10 mm clearance to prevent grounding out against adjacent components.

8. All seat trim fasteners (head & tip) must have a minimum of 5 mm clearance to its surrounding interface areas including full seat travel of the seat mechanism (Up / Down, Fore / Aft) to prevent squeaks & rattles.

9. Design Clearances between the upper and the lower channels of the seat tracks are very critical and necessary to achieve a low sliding effort and not create chucking / rattles.

10. Except at attaching points, provide a minimum of 5mm clearance between structural brackets to avoid metal to metal creaks. All points of contact should be attachments.

Isolation (I)

1. Use isolation at sides of vinyl or leather seat cushion to prevent squeaks and itches against adjacent surfaces.

2. Use isolation at interface of vinyl or leather armrest to seat back to prevent squeaks and itches.

3. Use isolation at interface of vinyl or leather seat back to seat cushion to prevent squeaks and itches.

4. If an under seat storage bin is used, it is recommended to line with a soft, compliant material along the bottom and sides to minimize rattle noises between the container and its contents.

5. It is recommended to use polypropylene, TPO, or polyethylene on any plastic seat belt escutcheon that is attached over or next to vinyl or leather seats to prevent itches. If these materials are not used, isolation will be required.

6. If preloading interfacing parts is not possible, it is recommended using a plastic or rubber coating on all metal linkages and attachment points in the seat recliner mechanism to prevent rattles.

7. Isolation is required at interface of vinyl or leather headrest to seat back to prevent itches

Body – Appendix III – Seats, cont.

8. To reduce seat back chucking, nonmetallic bushings and washers are recommended at the main recliner pivot point.

9. Seat track shields that interface the vinyl or leather seat cushions shall to be made of Polypropylene, unpainted TPO, or polyethylene, or isolation is required at the interface.

10. Seat cushion support mat wires must be plastic coated at the interface to the seat frame to prevent squeaks.

11. Seat back recliner coil spring ends must have lubrication at the interface to the seat structure to prevent squeaking.

Structure (St)

1. Use ribbing on inside of plastic sidetrack shields to help maintain their structural integrity under all thermal conditions to avoid contact with other parts and prevent squeaks & rattles.

2. Headrest post(s) and guides shall be designed with sufficient rigidity so that no relative movement is allowed between secured items to prevent rattles.

3. Ensure surface contact between seat attachments and the mounting surfaces. Point or partial contact must be avoided.

4. Ensure that the seat attachment to the floor is as close to the vertical portion of the seat leg as possible to increase seat stability and avoid seat foot rattles to the floor. Also, minimize leg cantilevered bends which decrease seat structural rigidity. Consider adding stiffening ribs and/or darts at the corners to maximize structural rigidity.

Secure (Se)

1. Seat wiring harness connectors and wiring shall be secured every 150mm with preloaded attachments to prevent connector and wires from rattling against floor or seat assembly.

2. Seat mechanism cables shall be properly secured every 200 mm to prevent from rattling against seat and surrounding components or isolation will be required.

3. All mechanical linkages shall be preloaded, in their natural design state, (e.g. Recliner handle, recliner shaft) or isolation will be required to prevent squeaks and rattles.

4. Staked hinge pin pivots are not recommended. Shoulder bolts are recommended to minimize tolerance variation and prevent pivot looseness.

5. Articulating headrest post(s) shall have an interference fit to the seat attachment or be pre-loaded to prevent loose headrests and consequent rattles.

6. All seat tracks shall be preloaded to prevent chucking / rattles.

7. If a seat belt assembly is attached to the seat, ensure surface contact between the seat belt anchor assembly and the seat mounting surface. Point or partial contact shall be avoided. Multiple attachments are strongly recommended and cantilevered supports shall be avoided.

8. Positive attachments are recommended to mount seat belt anchor plates.

9. Seat cushion material located between the structure and seat fabric must be secured to the structure with attachments that prevent relative motion, or isolation is required.

10. Fasteners attaching seat components to metal or other hard portions of the seat must be preloaded to prevent relative motion.

Body – Appendix III – Seats Belts

Klearance (Clearance)

1. The buckle shall be designed to angle away from the console and provide a minimum of 15mm clearance between the buckle assembly, in its free state, and the console. If this is not obtainable, the sleeve may be enlarged to provide an interference fit, given the materials are compatible, or isolation will be required. This is to prevent the buckle assembly from rattling against the console.

2. Adjacent buckles shall have clearance to each other in all service conditions or be secured together. If clearance of adjoining buckles is not obtainable, isolation is required.

3. A webbing button or sewn flap is recommended to position the latch plate assembly and provide clearance to unfriendly surfaces when in the stowed position.

4. Guide loop bushings are recommended to locate the guide away from the trim.

Isolation (I)

1. Isolation shall be required when any part of the seat belt buckle assembly can contact vinyl or leather seat trim. This may not be necessary if an anti-squeak top coating is applied to the seat side facing or if compatible materials are used.

2. Isolation shall be required when any part of the seat belt latch plate assembly will contact unfriendly or incompatible surfaces.

3. The use of Polypropylene for seat belt buckles and covers has proven to be a robust design in the prevention of squeak and itch noises between the buckle and the seat covering.

Structure (ST)

1. A stiffener may be used to reduce buckle assembly motion or to increase the resonant frequency to eliminate rattles.

Secure (SE)

1. Free play shall be minimized when using shoulder bolt attachments. Isolation is requiredif free play still allows rattles.

2. A retention strap may be used to help hold the buckle assembly to the seat to reduce lateral motion. Cloth straps (or equivalent) are recommended.

3. Ensure full contact for components that have one attachment point. Robust anti-rotation provisions are recommended (i.e. preloaded tab) to prevent unwanted rotation and cause possible squeaks and rattles. Point or partial contact must be avoided.

4. In the latched position, the seat belt buckle shall provide sufficient preload on the latch plate tongue to prevent rattles.

5. The seat belt buckle release button preload shall be sufficient to prevent rattles in both the latched and unlatched conditions.

6. Sufficient belt tension is recommended to minimize latch plate assembly free swing and rattles when in the stowed position.

7. Seat belt buckle wiring harnesses must be securely retained in position with pre-loaded clips.

8. Seat belt buckle sleeves must be securely attached to the belt assembly to prevent rattles.

9. In order to prevent rattles, it is recommended that all seat belt labels be heat applied or label sewn to belt so that label does not have a loose end.